

Seasonal Variations of Surface Radiation and Energy Balance* over Arctic Sea Ice during the N-ICE2015 Experiment

Lana Cohen¹, Stephen Hudson¹, Sarah Murphy², and Von P. Walden²

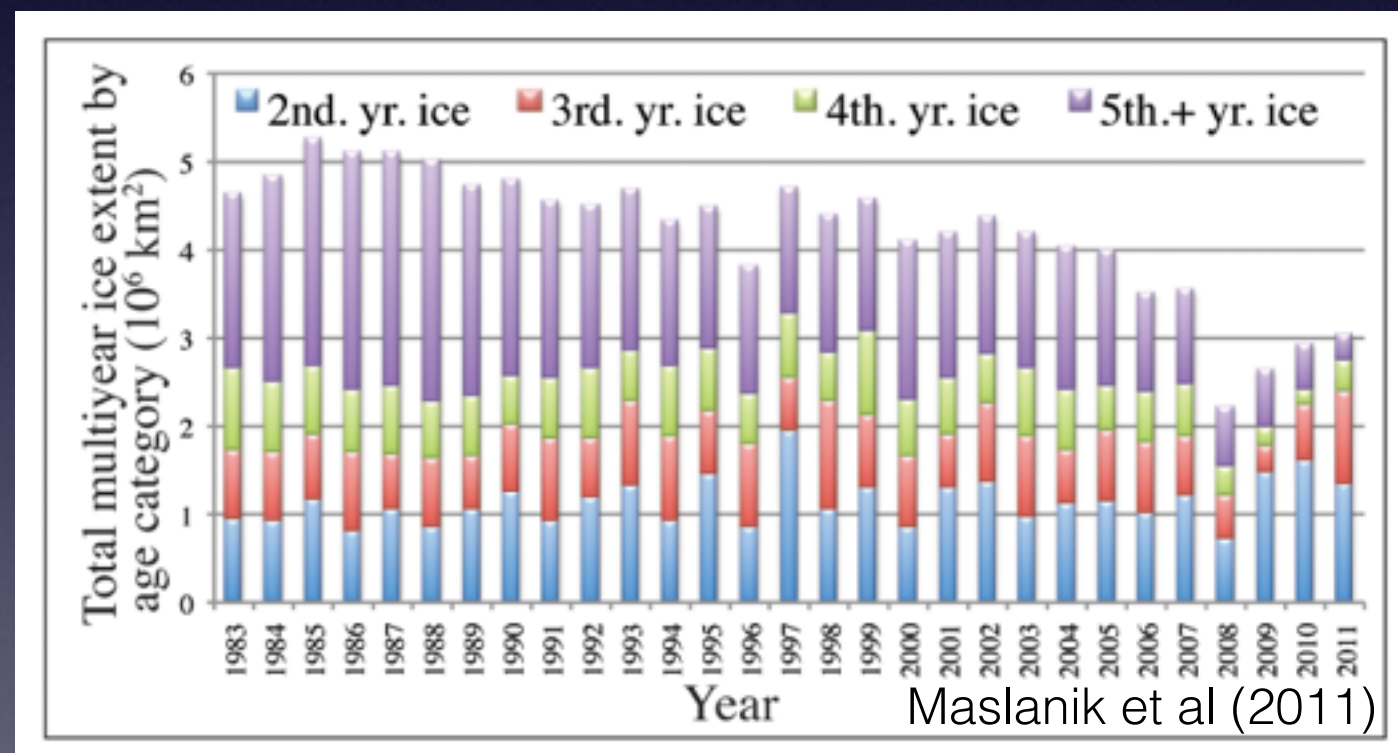
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* All radiation and turbulent flux data are PRELIMINARY!

Context

- Long-term trend of Arctic sea becoming younger and thinner
 - e.g., Fowler et al, 2004; Maslanik et al (2007, 2011); Stroeve et al (2012)



- Very few comprehensive measurements in seasons other than summer (since SHEBA in 1998)

N-ICE2015

Norwegian Young Sea Ice experiment

January - June 2015

January



Granskog et al, 2015, EOS

May



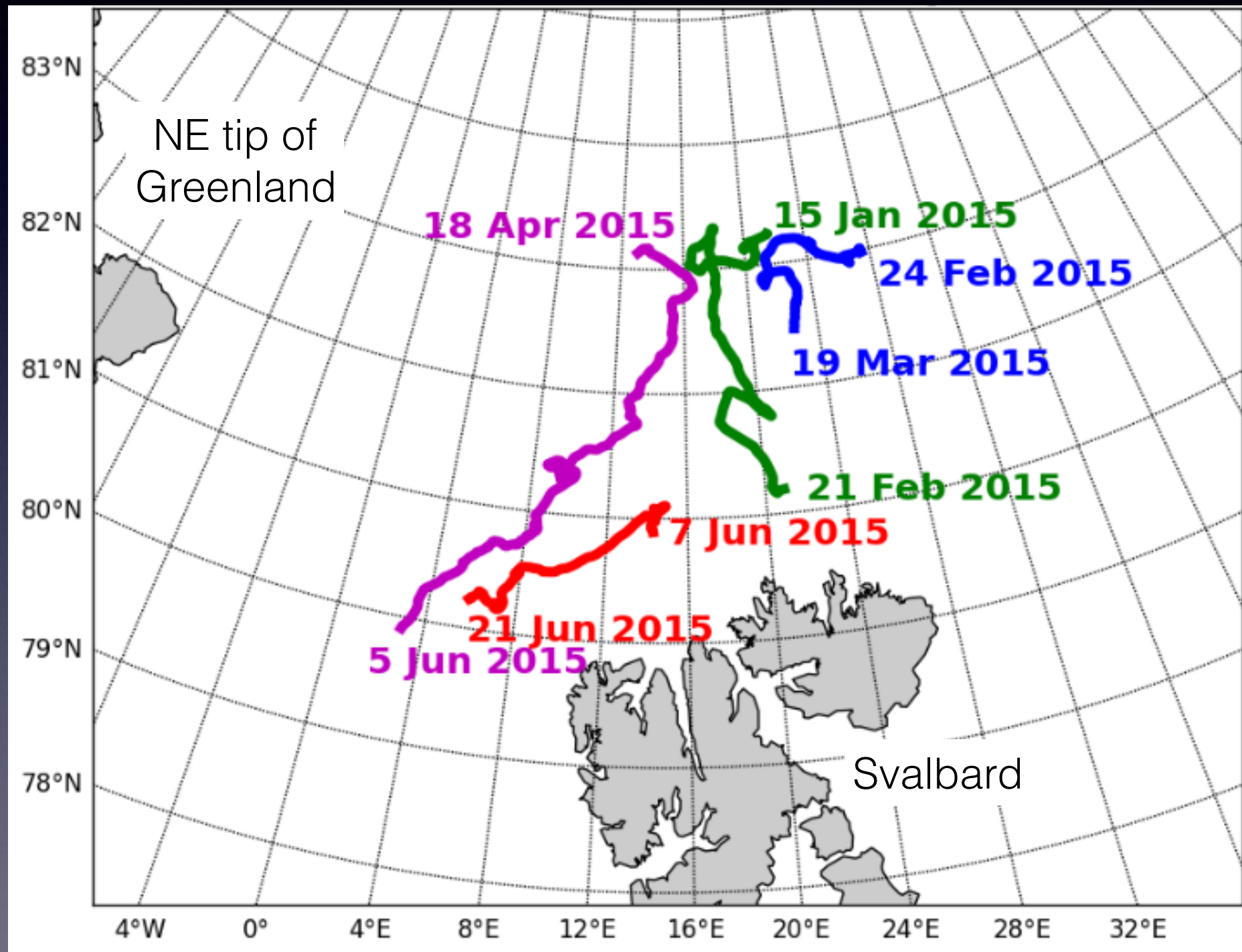
N-ICE2015

- To understand the effects of new thin, first-year, sea ice regime in the Arctic on energy flux, ice dynamics and the associated ecosystem, and local and global climate.
 - 5 Working Packages
 - WP1 - Physical Oceanography
 - WP2 - Atmosphere
 - WP3 - Sea Ice
 - WP4 - Sea Ice Dynamics
 - WP5 - Ecosystem Dynamics

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N-ICE2015



N-ICE2015

23 May 2015

First-year
Ice (~1 m)

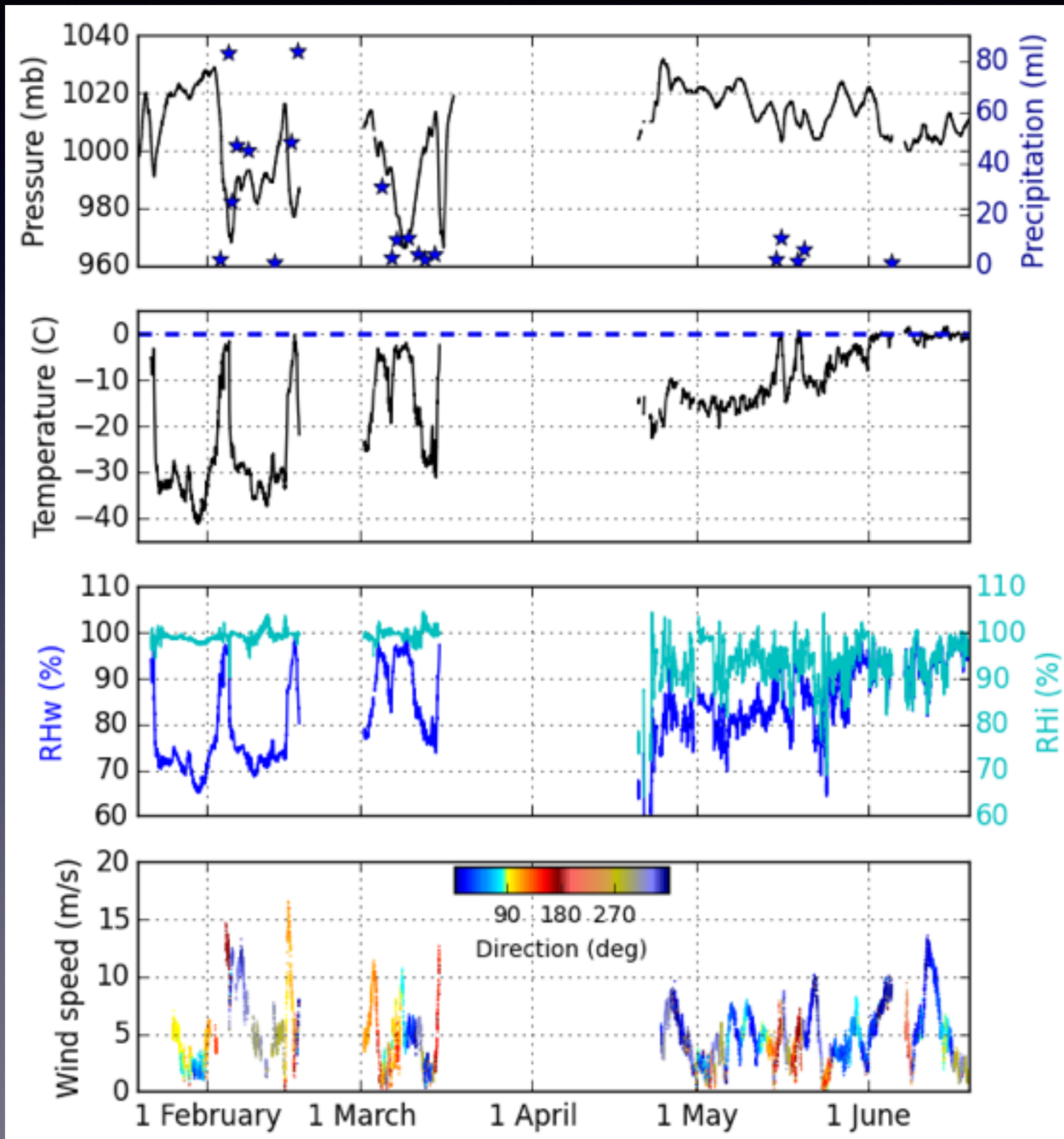


Refrozen Lead (20 cm)

Instruments

- 10-meter meteorological tower
 - RM Young T, Vaisala humidity, Lufft Ventus winds
- Kipp and Zonen shortwave and longwave radiometers
- Licor Eddy-Covariance system (EC) (3 systems)
- Vaisala Ceilometer (CEIL)
- DOE ARM Micropulse Lidar (MPL)

Meteorology



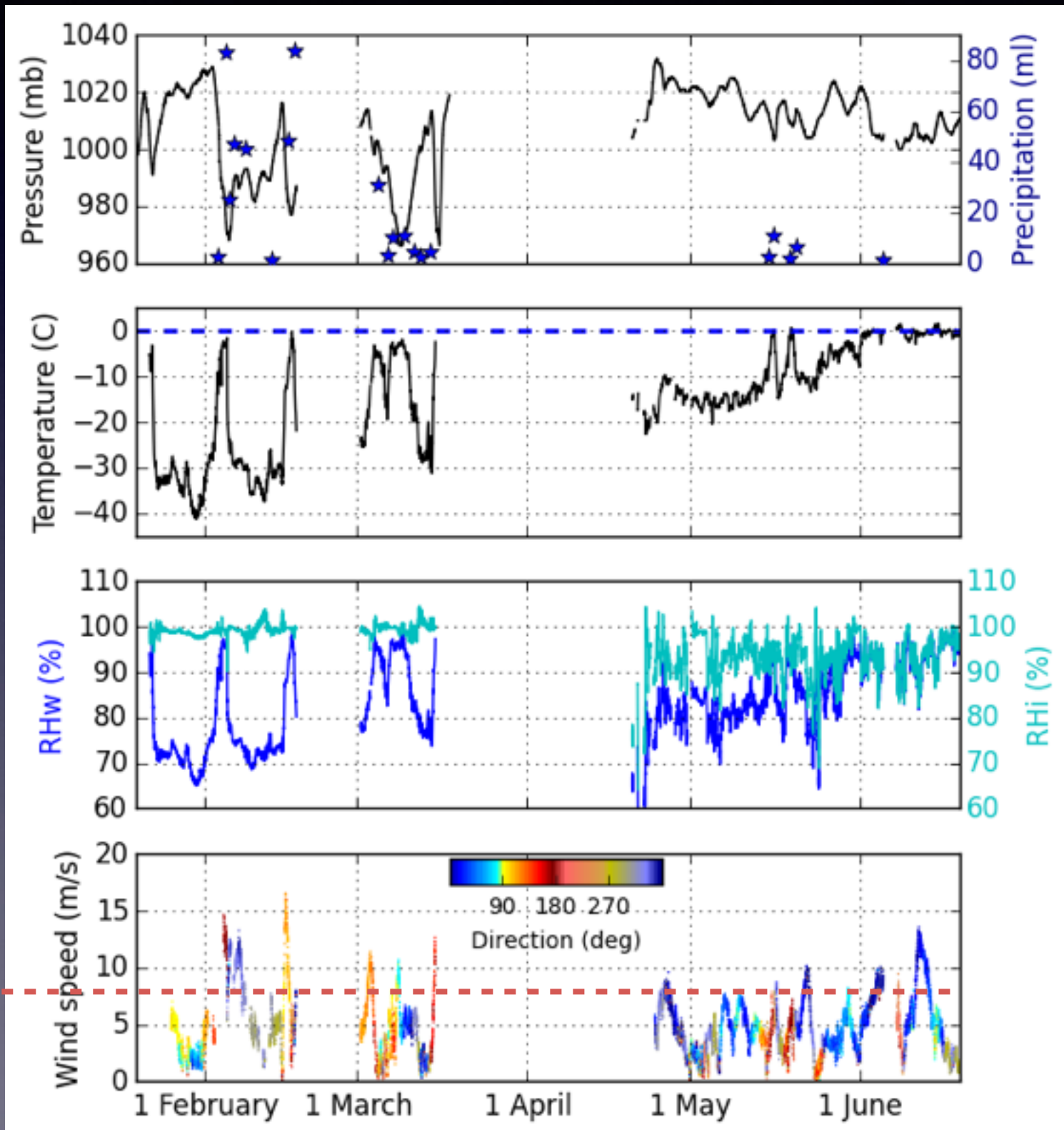
Meteorology

Large P drops
in winter

Very large T
increases
in winter

Little change
in RH_i;
large RH_w

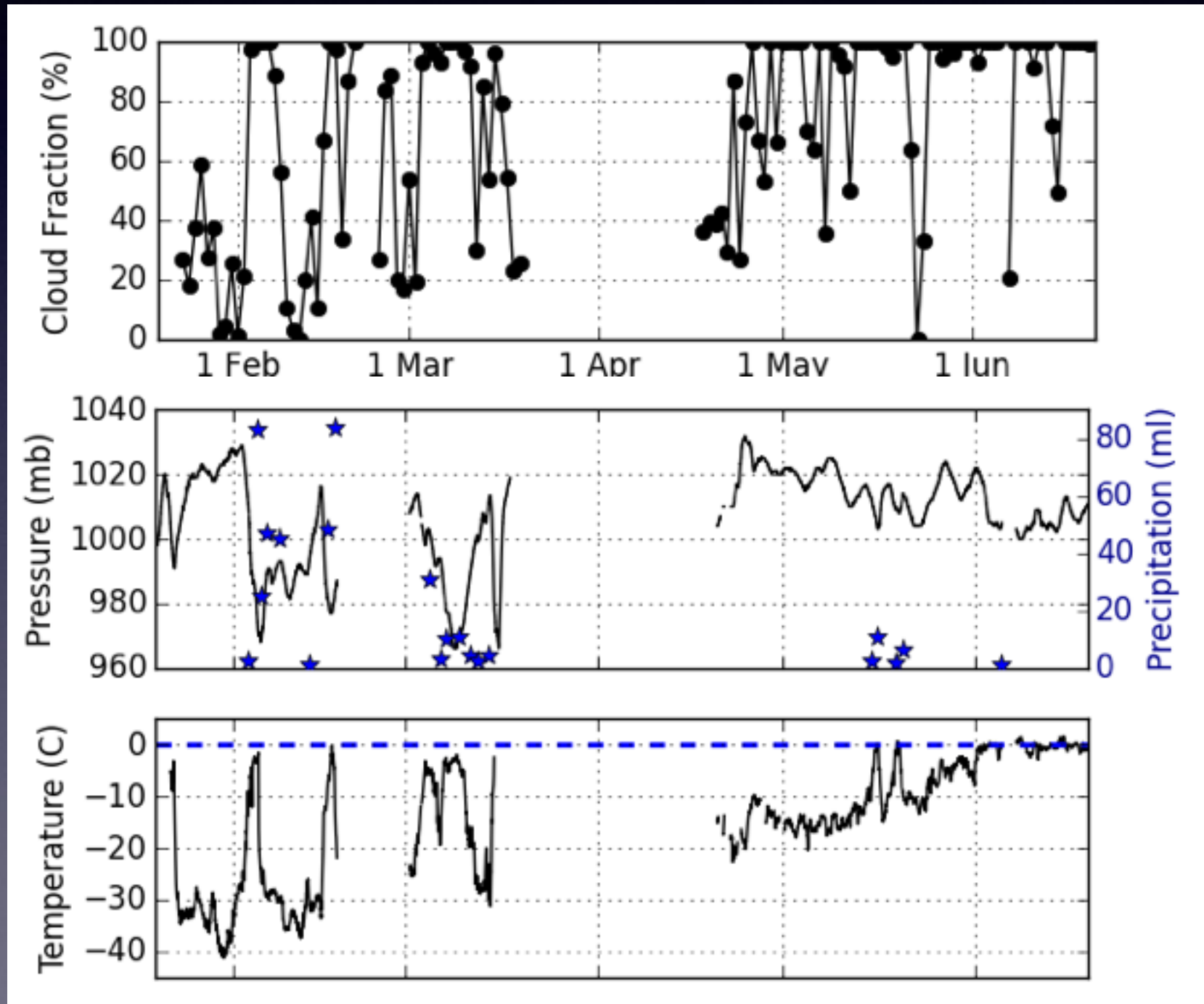
$ws > 8 \text{ m/s}$



Cloud Fraction

Ceilometer

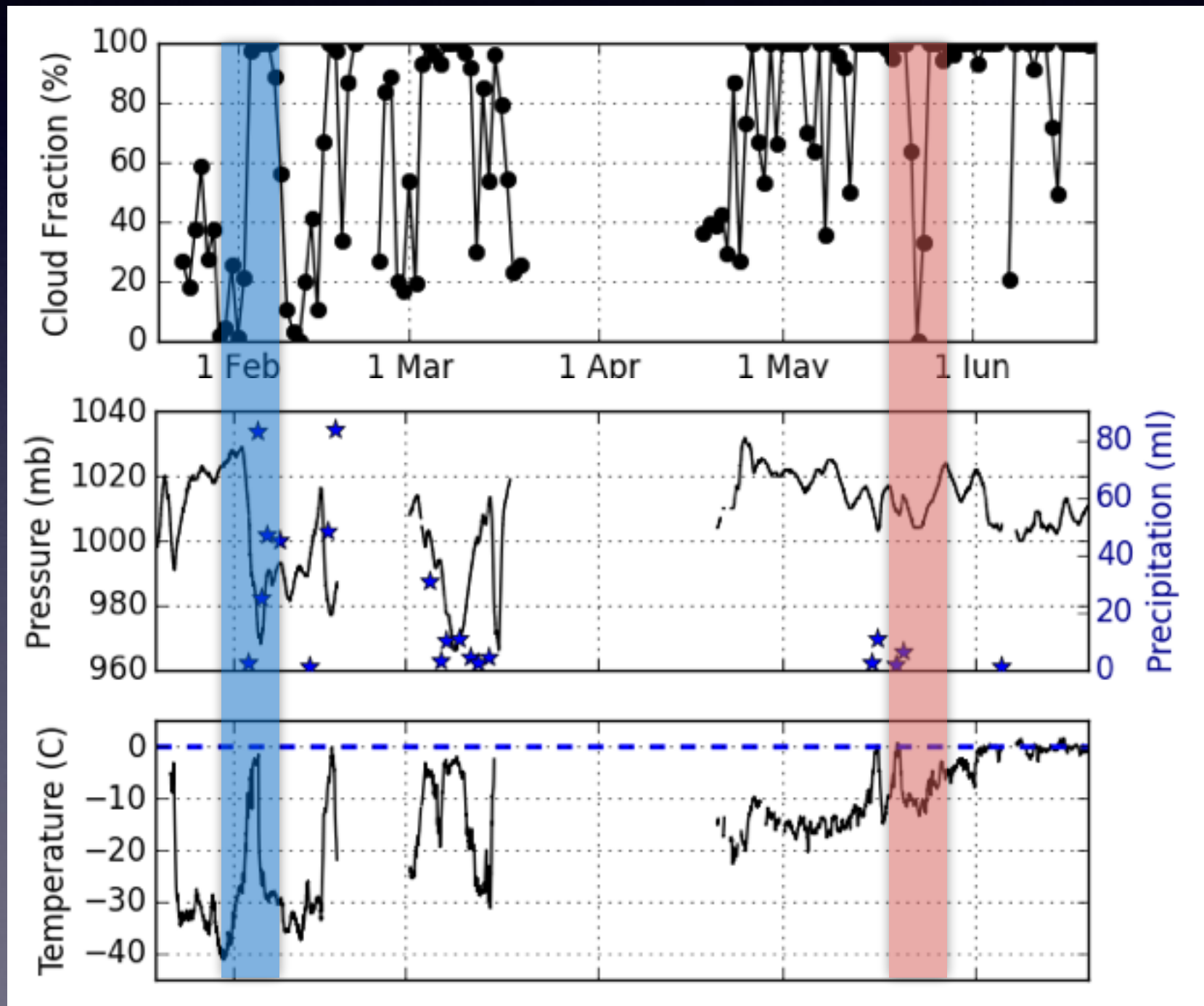
47% 68% 80% 88%



Cloud Fraction

Winter Case

Spring Case

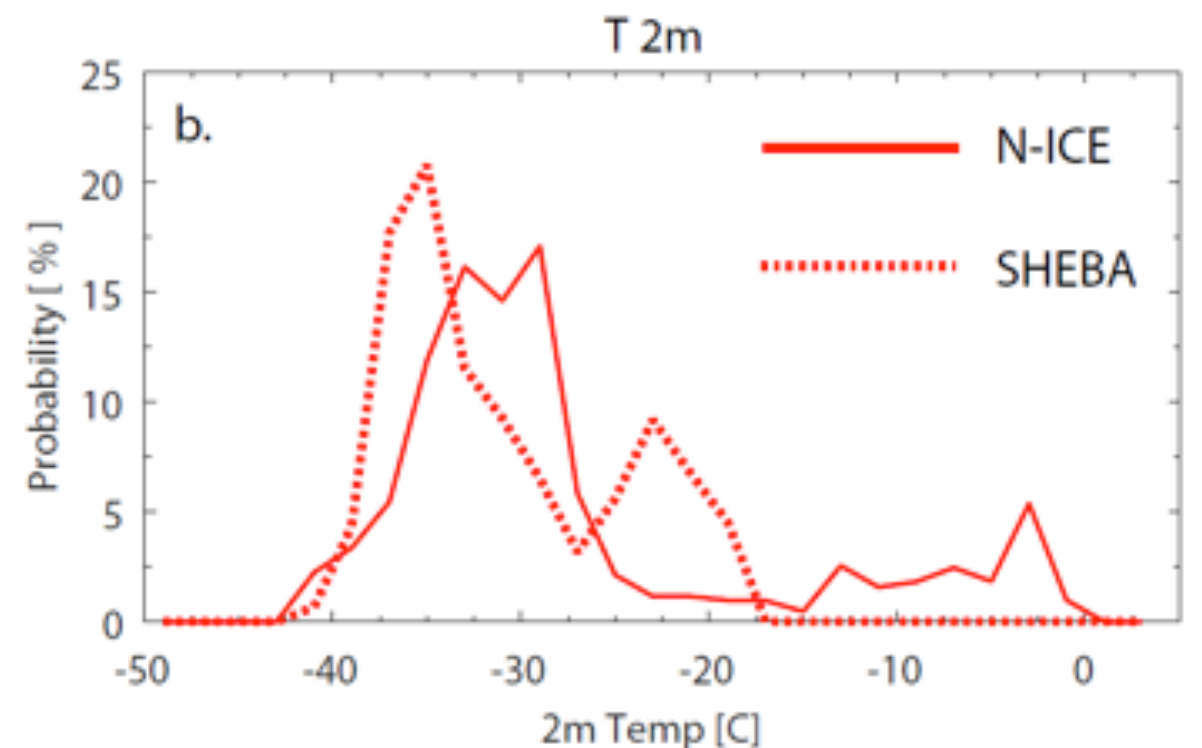
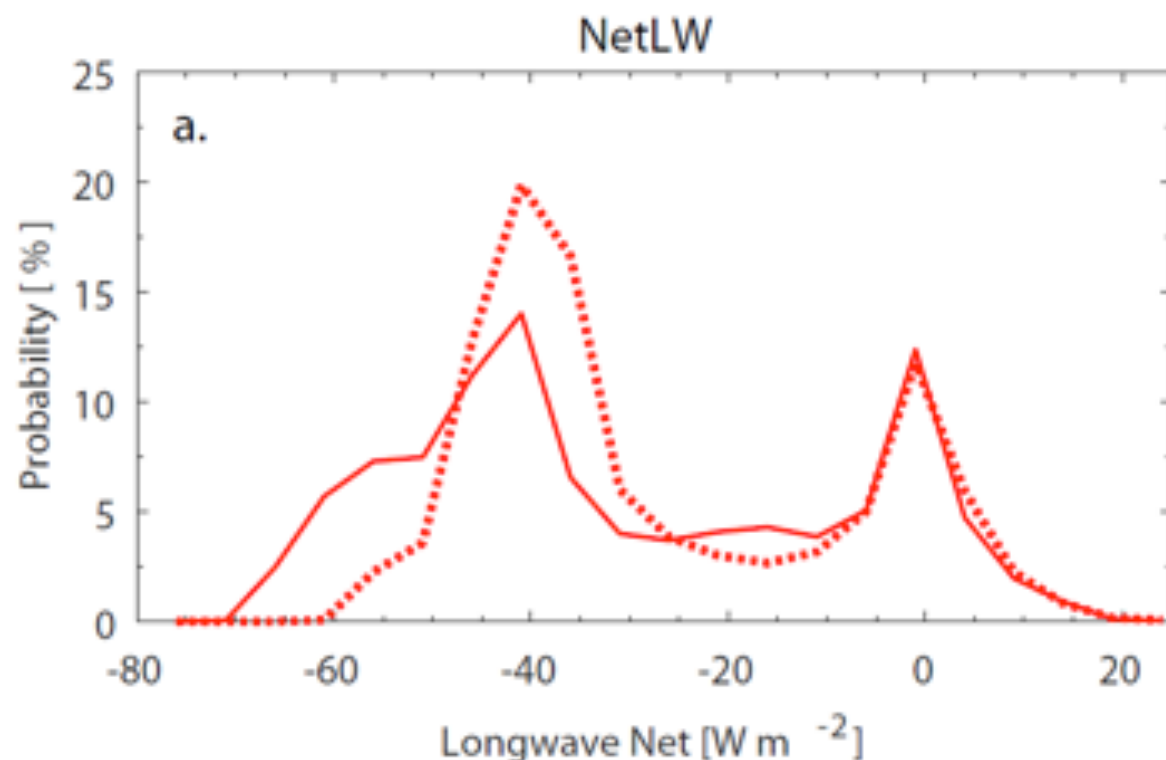


SHEBA Comparison

A comparison of the two Arctic atmospheric winter states from the N-ICE and SHEBA campaigns

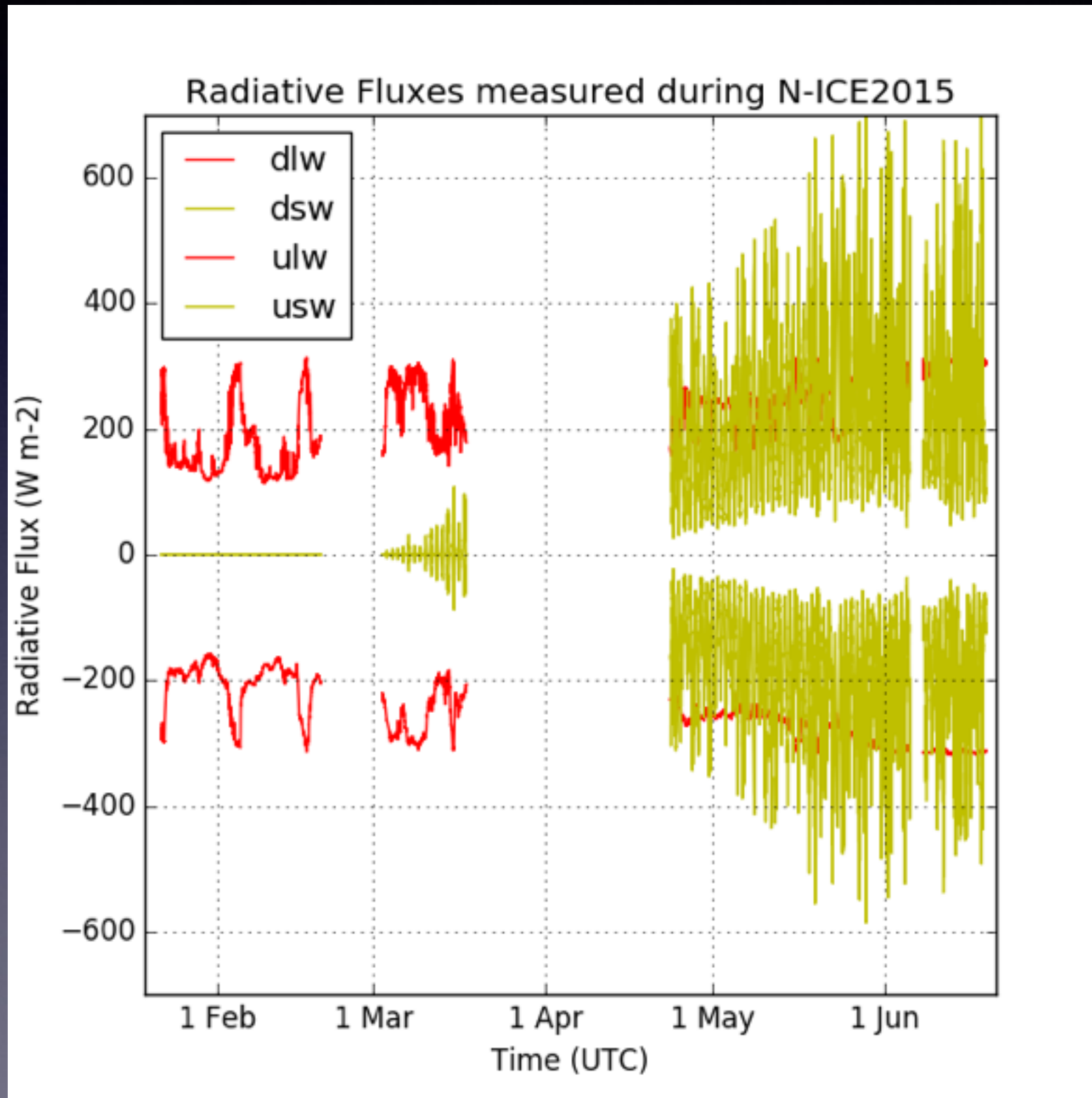
Robert M. Graham^{1,2}, Annette Rinke¹, Lana Cohen², Stephen R. Hudson², Von P. Walden^{2,3}, Markus Kayser¹, Marion Maturilli¹

In Preparation for N-ICE Special Issue in JGR



Radiative Fluxes

Fluxes are
positive
INTO
the surface

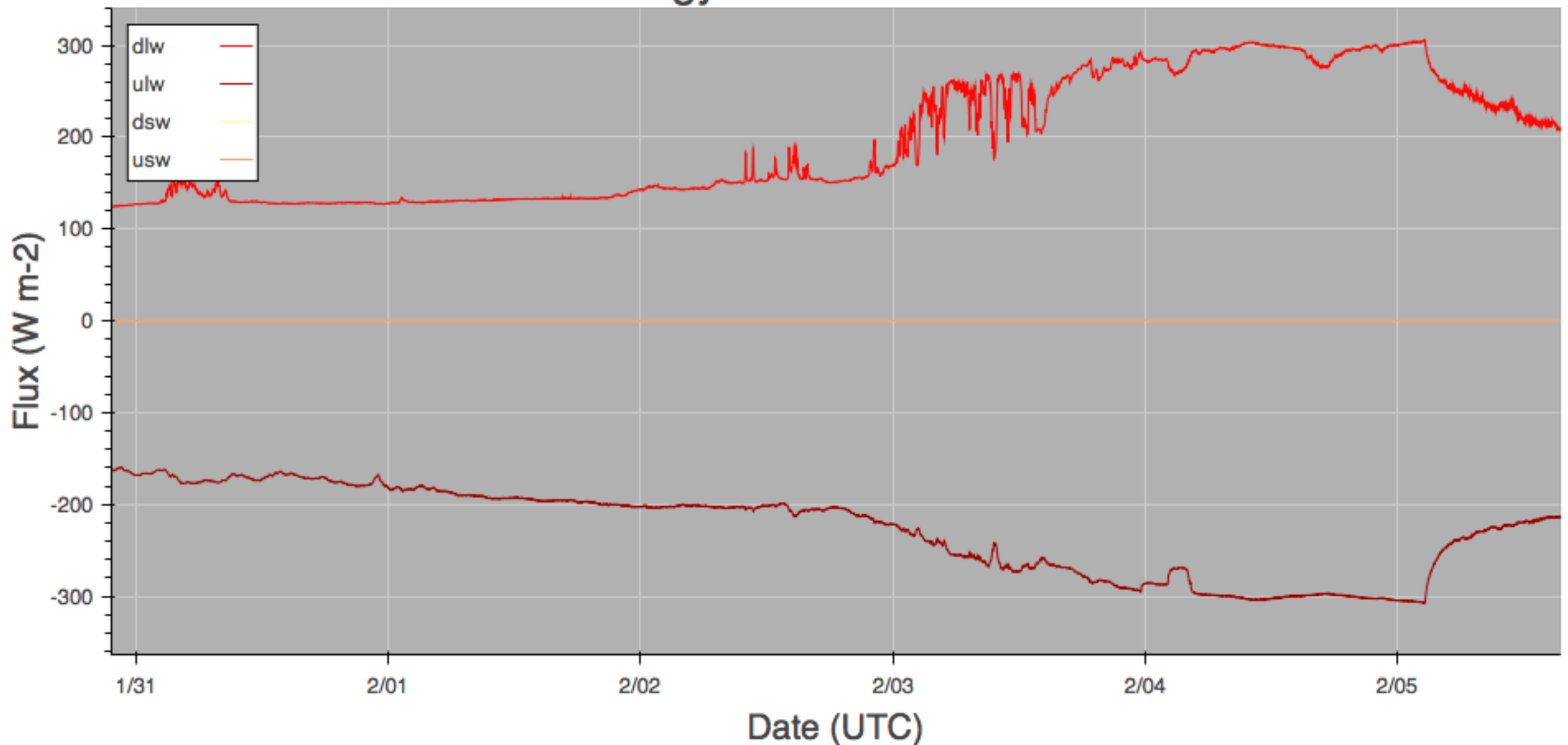


Downwelling

Upwelling

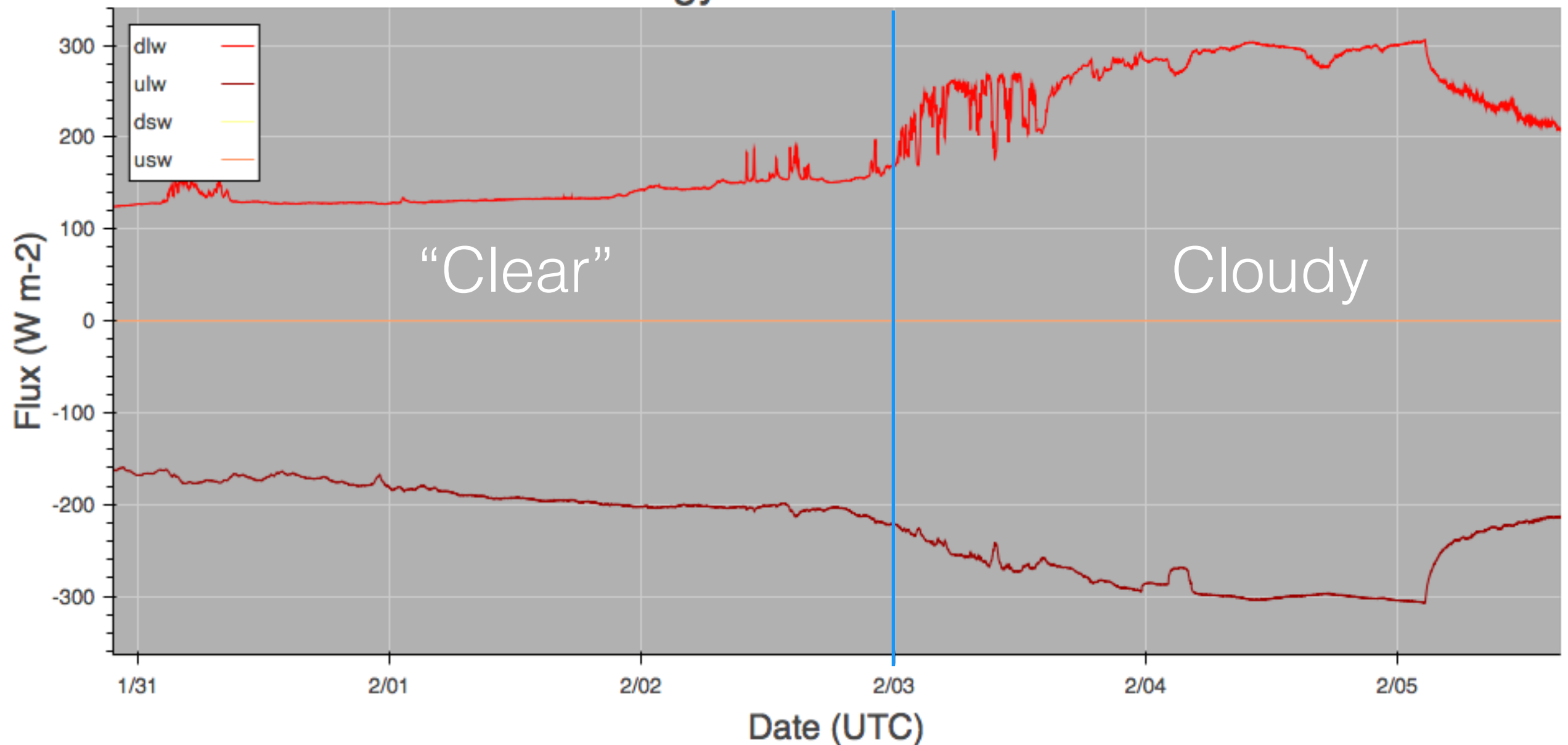
Winter Case

Surface Energy Balance from N-ICE2015



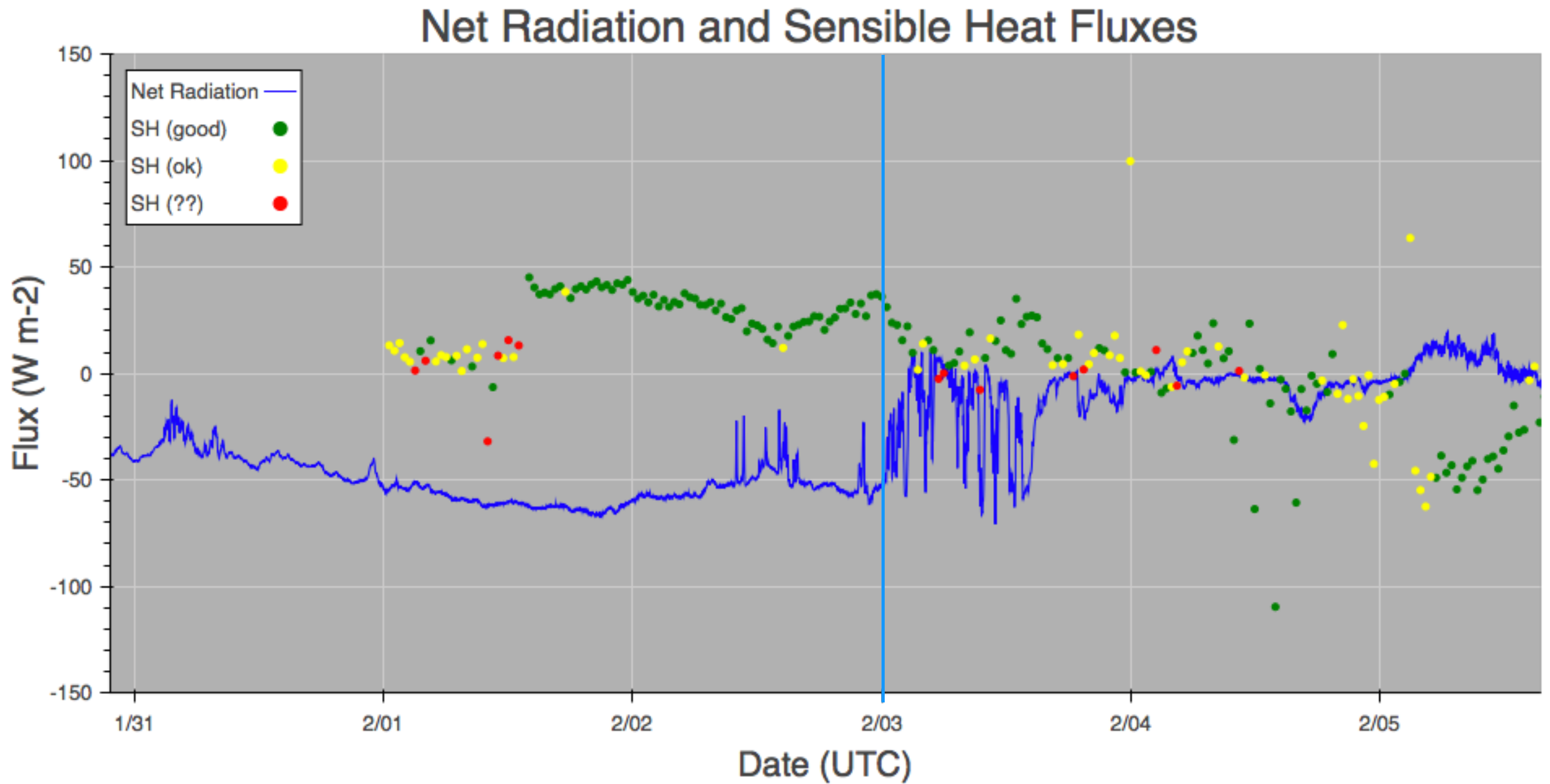
Winter Case

Surface Energy Balance from N-ICE2015



2015-01-31	25
2015-02-01	1
2015-02-02	21
2015-02-03	97
2015-02-04	100
2015-02-05	100
2015-02-06	100

Winter Case

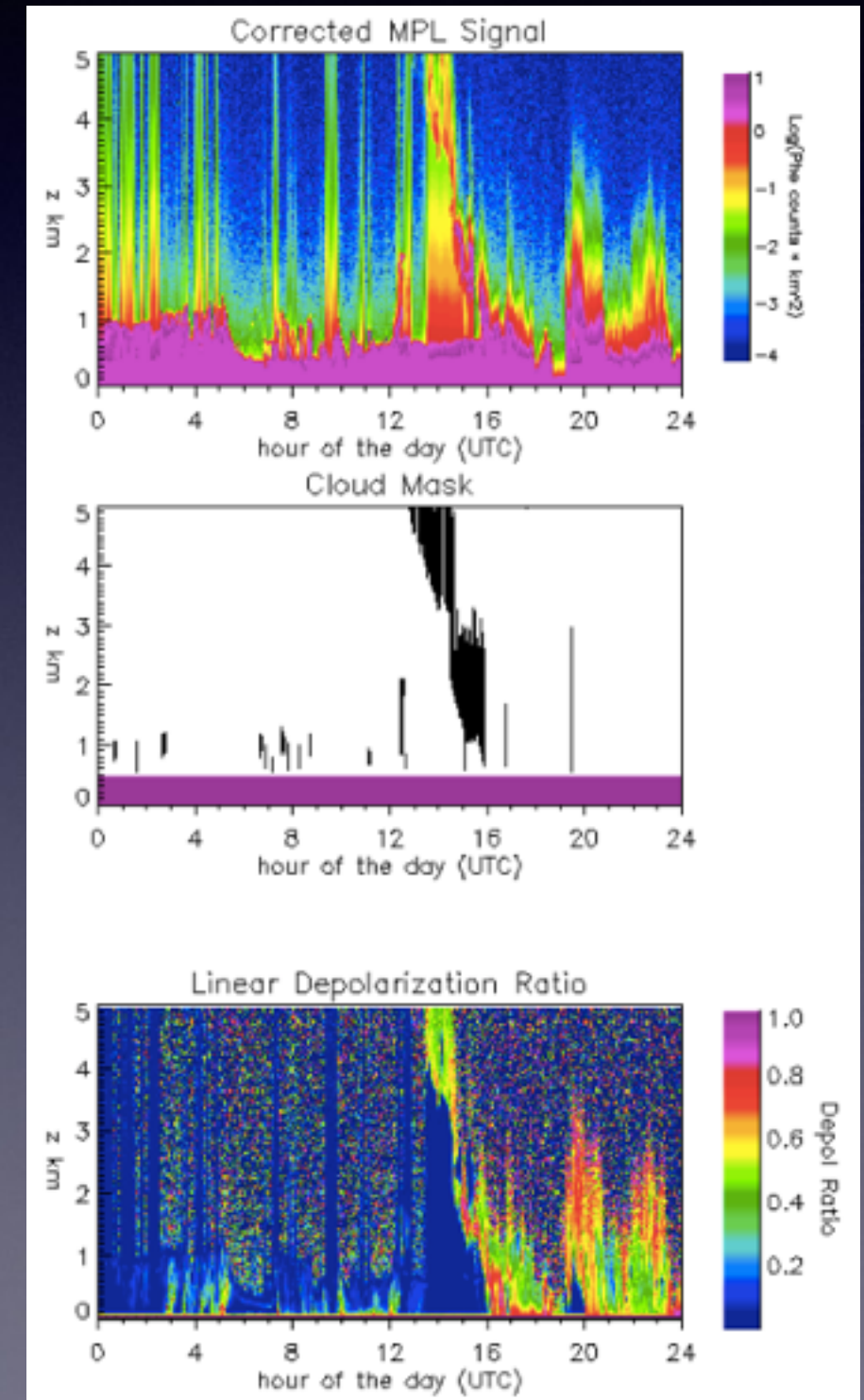
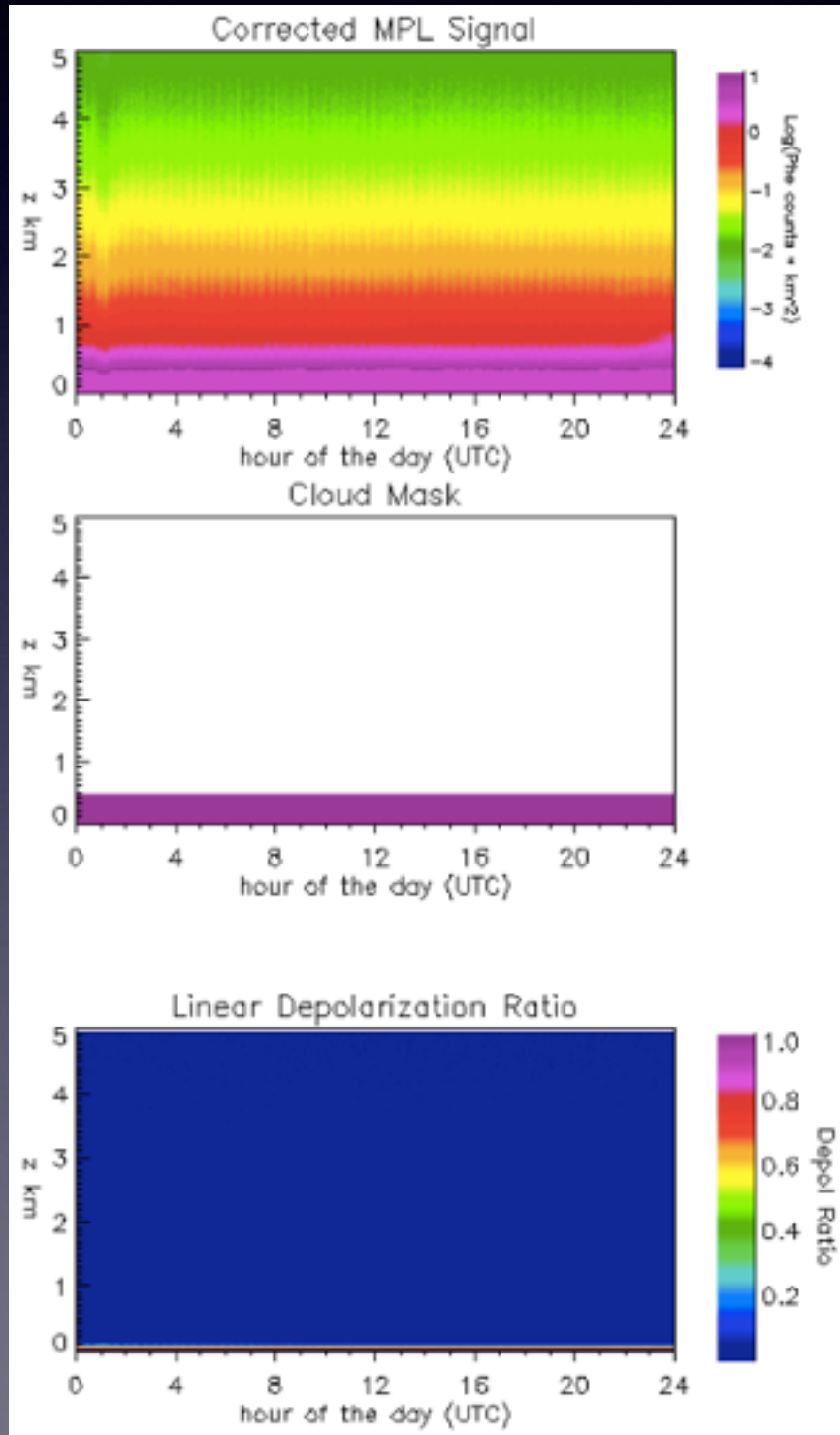


Winter Case

31 Jan

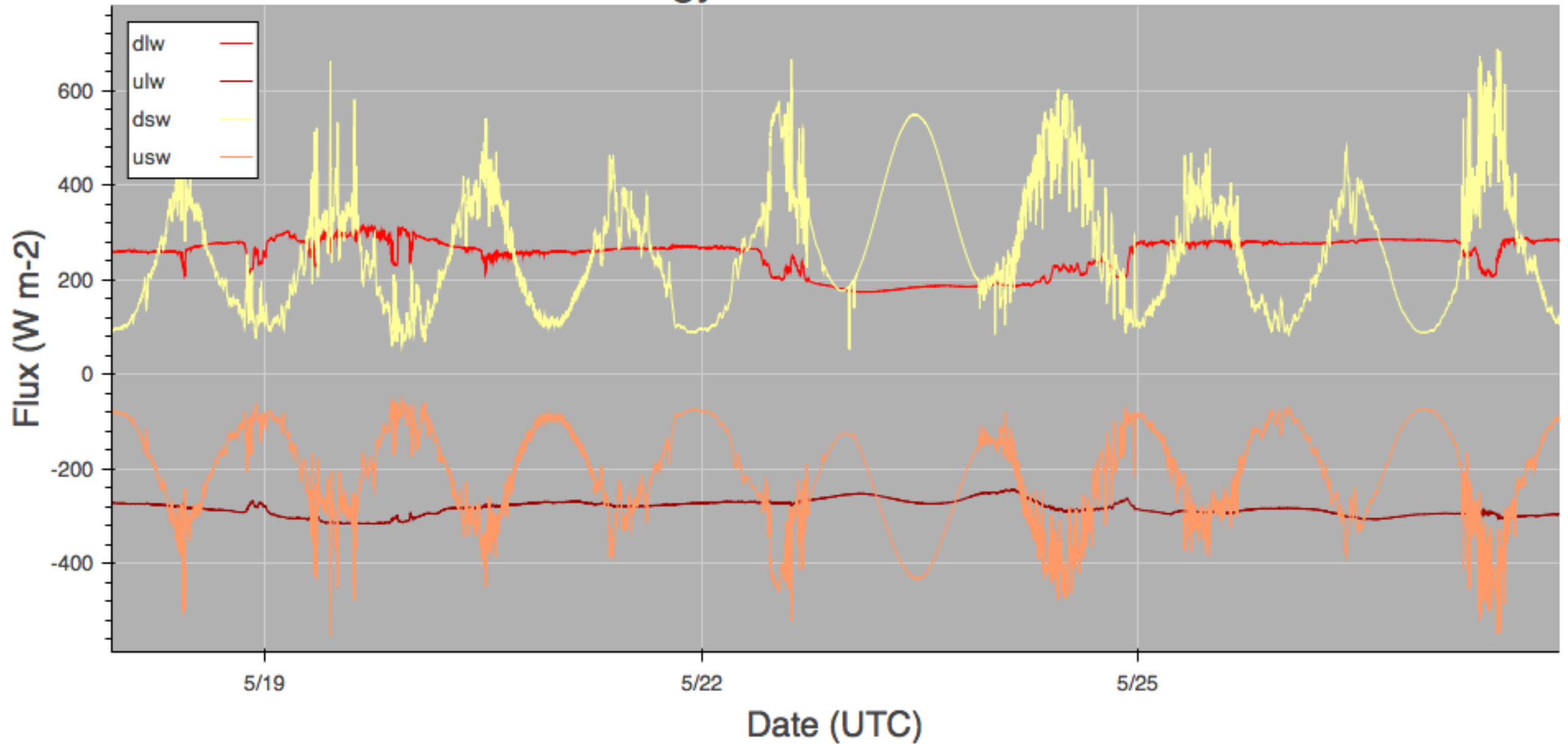
3 Feb

Micro-
pulse
Lidar



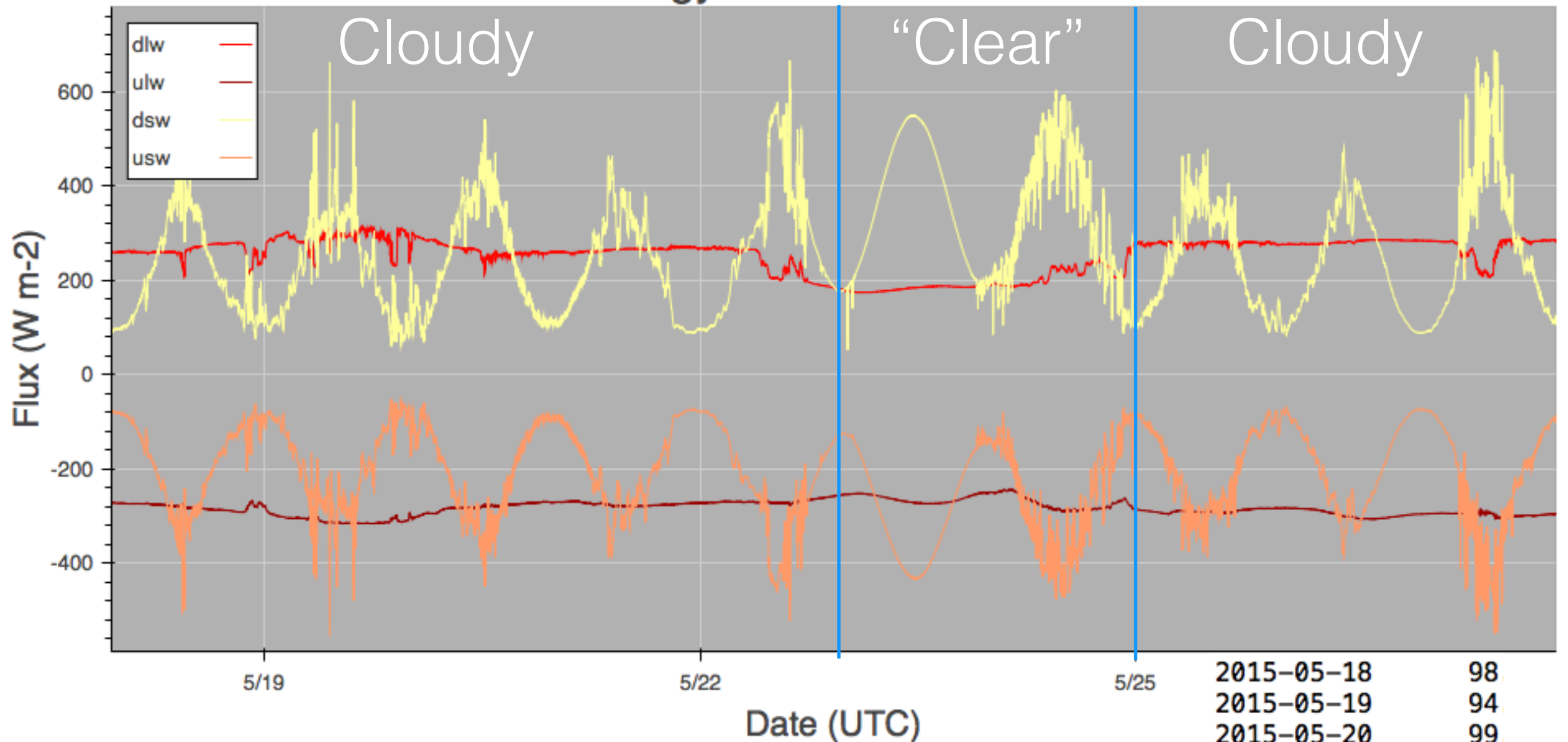
Spring Case

Surface Energy Balance from N-ICE2015



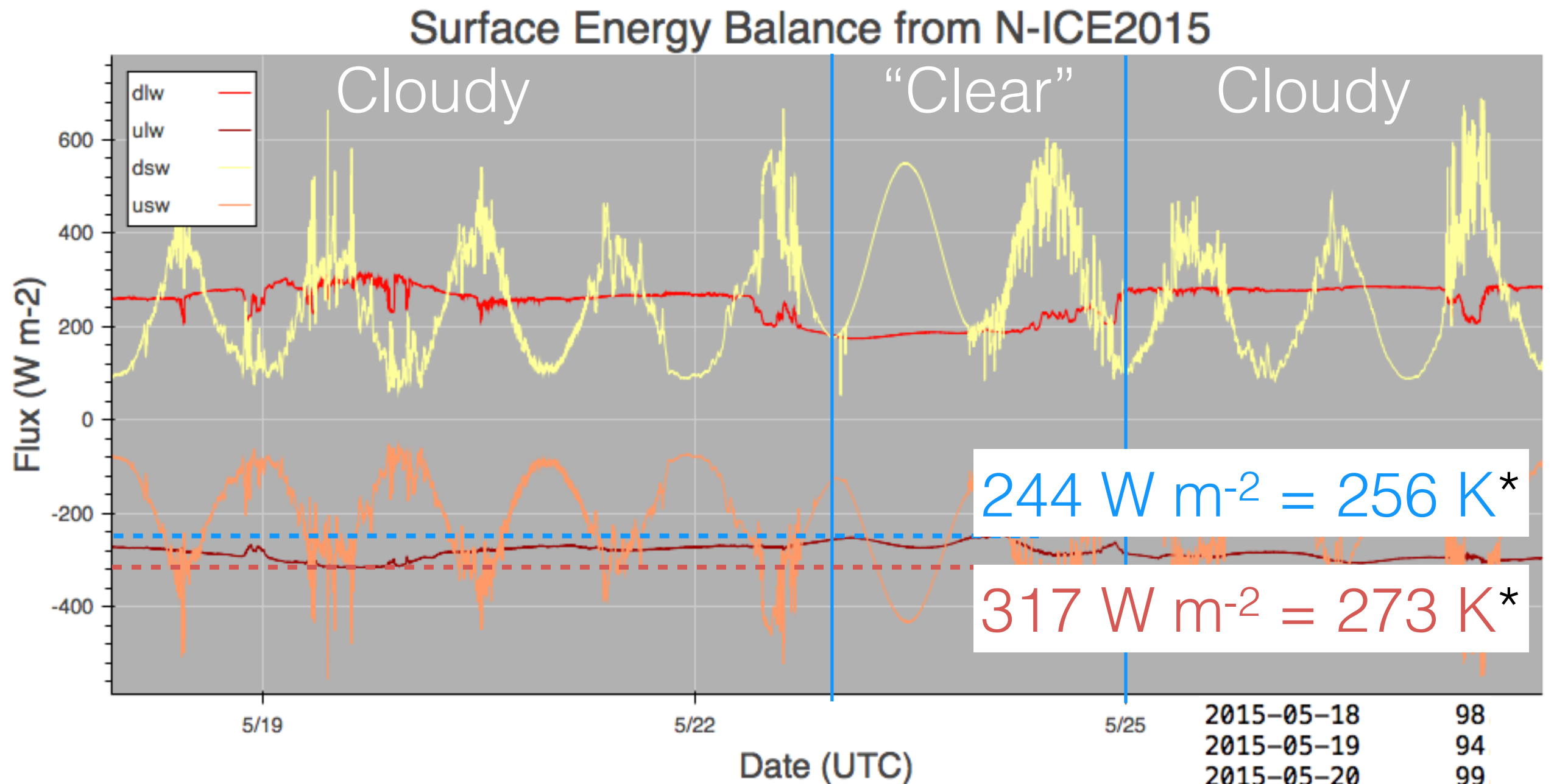
Spring Case

Surface Energy Balance from N-ICE2015



2015-05-18	98
2015-05-19	94
2015-05-20	99
2015-05-21	100
2015-05-22	63
2015-05-23	0
2015-05-24	33
2015-05-25	100
2015-05-26	100
2015-05-27	94

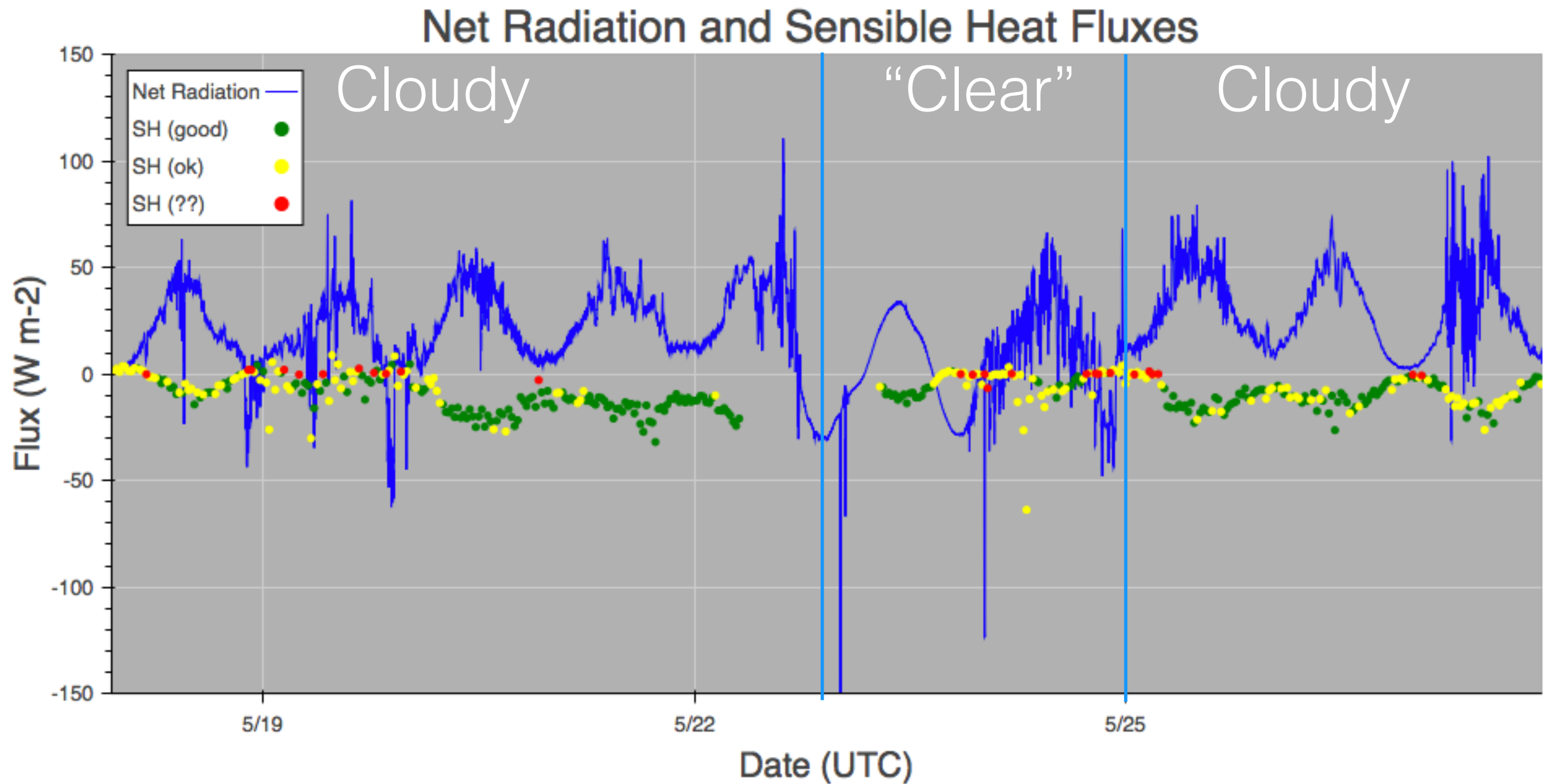
Spring Case



*assuming unit
emissivity

2015-05-18	98
2015-05-19	94
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2015-05-21	100
2015-05-22	63
2015-05-23	0
2015-05-24	33
2015-05-25	100
2015-05-26	100
2015-05-27	94

Spring Case

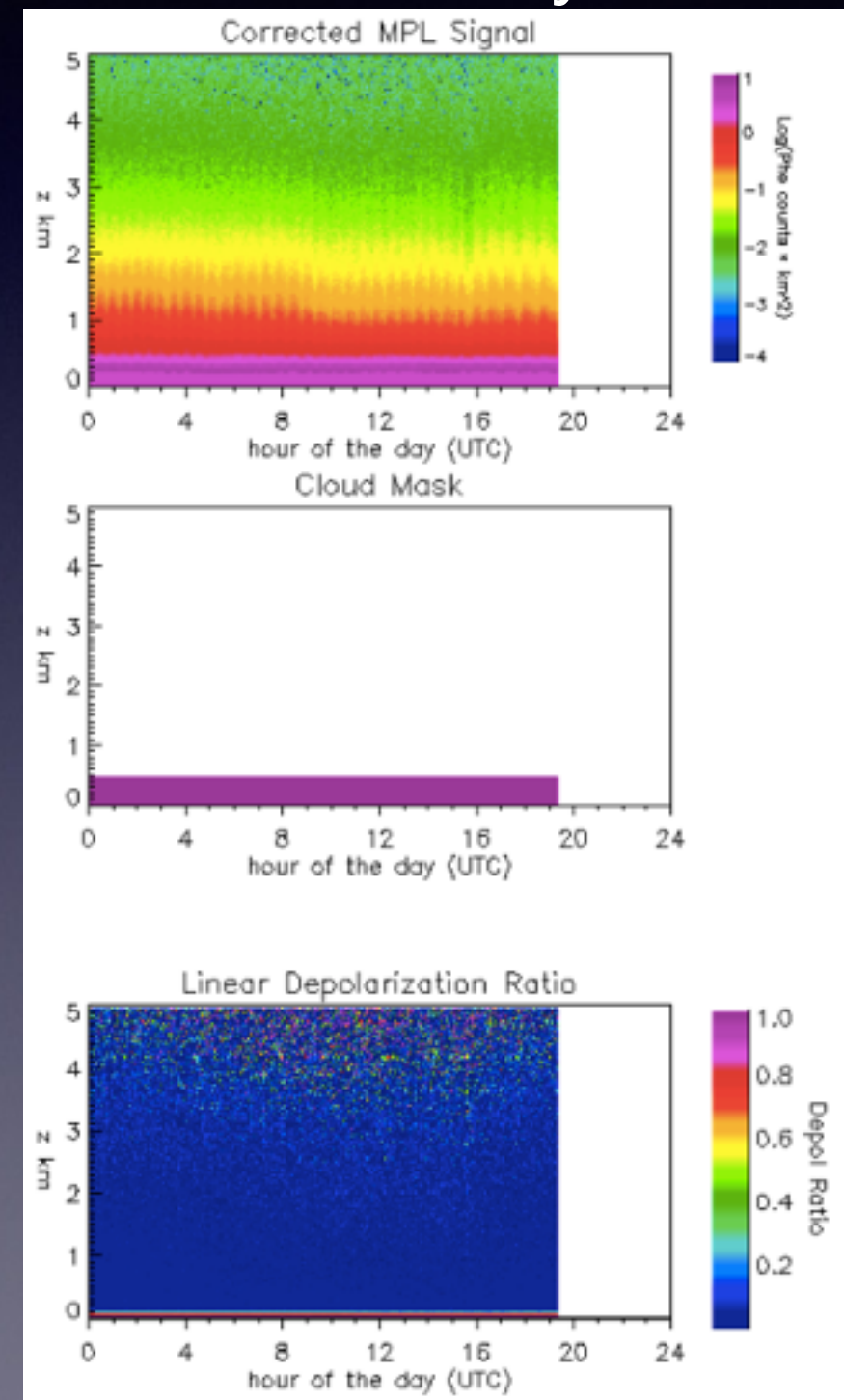
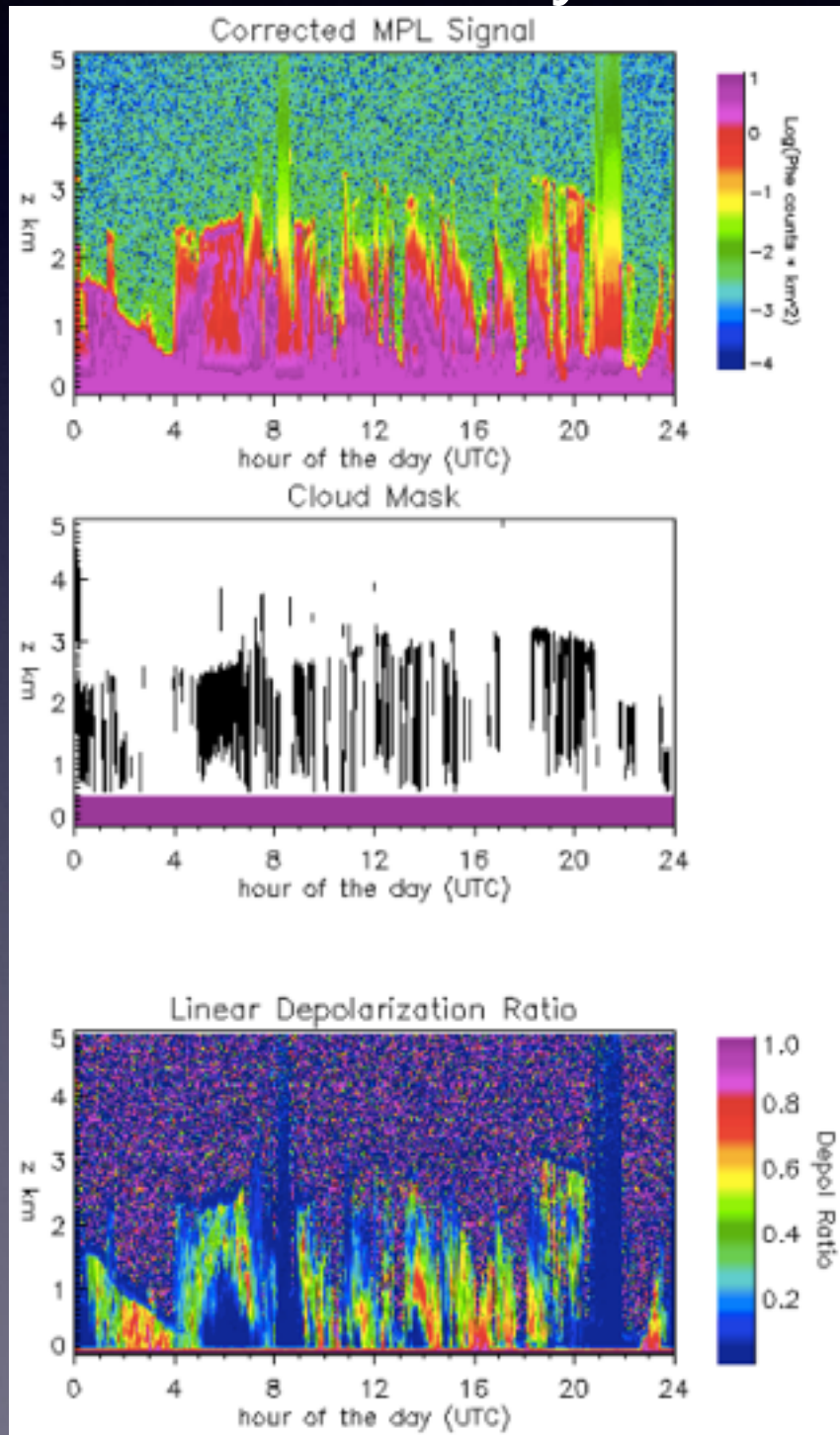


Spring Case

19 May

23 May

Micro-
pulse
Lidar



Conclusions

- N-ICE2015 was the first experiment over Arctic sea ice since SHEBA that spanned from winter into summer.
- Winter weather was variable, summer was not.
- Preliminary estimates of the surface energy balance indicate that latent heat fluxes are negligible, but sensible heat fluxes are not.
- Sensible heat fluxes do not balance the net radiation possibly due to oceanic heat flux through the sea ice.

Future Work

- Eddy-covariance inter comparison with two other systems and analysis software
- Year 1 has focused on “Disciplinary papers” to be published in a special issue of JGR
- Year 2 will focus on interdisciplinary research between the different work packages.

Thank you!

Acknowledgments

- Crew of the R/V Lance
- Chitra Sivaraman and Annette Koontz and the DOE ARM program
- U.S./Norway Fulbright Foundation
- College of Eng and Arch, Washington State University

Histograms

- Show histograms of radiative fluxes in different seasons

